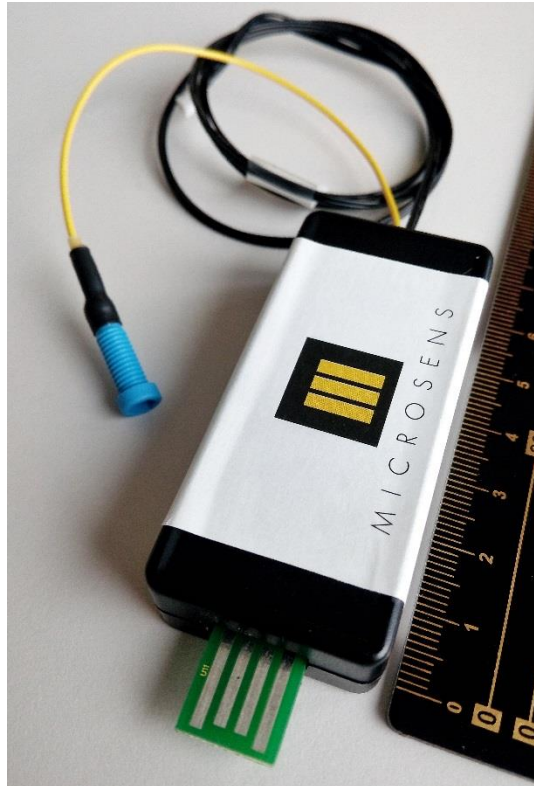# MSFET - USB

USB interface for the MSFET3330 and MSFET334x

Key Features

- Small packaging (40mm x 70mm)
- USB powered (galvanic isolation of in- and outputs)
- Digital sensor output
- pH calibration function
- Graphical user interface (Java)

Applications

- Laboratory
- Water quality monitoring
- Environment control
- Security and industrial process control

Characteristics

- Temperature range: 0°C … 80°C
- USB powered (galvanic isolation)
- pH calibration function
- Digital output of sensor output (raw data) and measured pH
- Data transfer via USART bus (2 wires)

Technical Specifications

	Min.	Typical	Max.	Unit
Power supply (USB)	4.95	5.0	5.05	V
Input current		30		mA
ISFET Vds		0.5		V
ISFET Id		0.1		mA
Baudrate		4800		

Measurement Specifications

	Min.	Typical	Max.	Unit
pH range	1		12	
Resolution:				
Sensor output voltage		1		mV
pH		0.02		UpH
Measurement frequency (recommended)		1		Hz

Communication

System commands

Command	Description
data	Demand the sending of data from the interface
cal_0	Start calibration
cal_<pH>	Record sensor output for a given pH. The pH value of the current buffer is entered in UpH*100. Example: cal_750 = record the sensor output for the current buffer of pH7.5
param	Print recorded ISFET parameters (V_{offset} [mV] and slope [mV * 100])
off_<V_{offset}>	Enter V_{offset} (e.g. from a previous calibration) into system memory
slp_<slope>	Enter slope (in mV*100) into system memory
dft_<drift>	Enter drift of sensor output voltage into system memory (in mV/day * 100)
ID	Print system ID (Format: MSFET_<ID#>)

Commands need to end with "\n".
Calibration must always start with the most central value of the range of interest.

System output structure

Data as well as system information is send after a command initiated it.

The "data\n" command will result in the sending of the data packed starting with "d". The other commands listed in the table above will result in the sending of data packets starting with "i".

Identifier		Content (in ASCII code)						
d	;	Sensor output voltage [mV]	;	Calculated pH	;	Checksum (of the previous characters)	\n
i	;	System information					\n

Graphical User Interface

The data sent by the MSFET3330 Interface can be read via the pH Measurement interface provided with the system. It can be downloaded via the MICROSENS website (direct link: www.microsens.ch/xchange/MSFET_Interface_Win10.zip).

The graphical interface is started by double clicking the "MSFET_Interface.jar" file in the "MSFET_Interface" folder. The program will open a file selection dialog, where the user can chose the *.txt file, where the measurement data will be stored. If an existing *.txt is selected, the data will simply be added to the document.
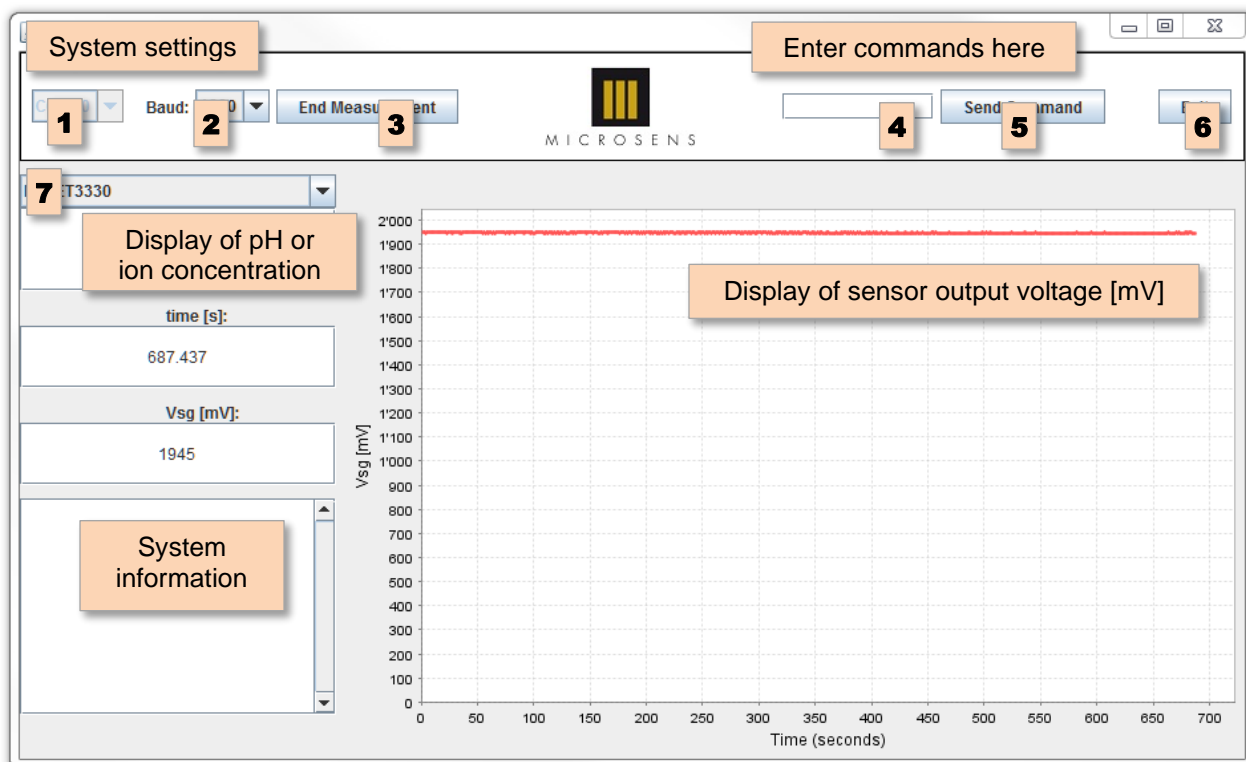
Once the measurement file is selected the graphical user interface will open, as shown in the above picture. In order to connect to the MSFET3330 Interface, the user needs to select the corresponding COM port (1). The baudrate should be set to 4800 for a correct communication between the PC and the MSFET3330 Interface (2). Clicking on "Start Measurement" (3) will start the measurement and the received data will be displayed.

For calibrating the system, commands (4) can be send to the MSFET3330 Interface via the "Send command" button (5). The corresponding system information will be printed in the system information window.

Measurements can be halted and restarted via the "End Measurement"/"Start Measurement" (3) button. At the end of the measurement simply close the window by clicking the "Exit" button (6). The ISFET type selection (7) allows toggling the output between pH and mM for ion selective measurements.

Example for pH calibration (using buffer pH7, pH4 and pH10):

1) Connect ISFET and reference electrode and plunge into pH buffer. Use the buffer which represents the central value of your range of interest (e.g. pH7).

2) Enter "**cal_0**" and click Send Command to start calibration function.

3) Wait for the sensor output Vsg to stabilize.

4) Enter "**cal_700**" and click Send Command to record the sensor output at the current buffer (**pH7**)

5) Change buffers - the next buffer is pH4 – and wait for Vsg to stabilize.

6) Enter "**cal_400**" and click Send Command to record the sensor output of the current buffer (**pH4**)

7) Change buffers - the next buffer is pH10 – and wait for Vsg to stabilize.

8) Enter "**cal_1000**" and click Send Command to record the sensor output of the current buffer (**pH10**)

9) The system will determine the calibration parameters and send them as system information as well as writing them to the system memory.

10) The sensor is now calibrated and ready for measurement.

Using the interface with the MSFET334x sensor line

The digital interface also works with the functionalized MSFET334x sensors. However, since the conversion is tailored to the pH nomenclature, the input for the calibration commands needs to be adapted accordingly.

The functionalized MSFET334x sensors generally have a linear response in the range of 10^{-5} M to 0.5M. In the pH nomenclature this corresponds to a range of 5 to 0.3, since we are using the $\log_{10}$ conversion (e.g. $\log(10^{-5} [M]) = -5$).

The following table gives a guideline for the commands for the calibration of MSFET334x sensors. The general conversion is as a simple logarithm: "pH" = - $\log_{10}$(concentration[M]).

Ion concentration [mM]	$\log_{10}$(concentration[M])	Calibration command
0.1	-4	cal_400
2	-2.7	cal_270
5	-2.3	cal_230
30	-1.52	cal_152
500	-0.3	cal_030

The sensor output will be converted into the pH nomenclature, which can be converted into the ion concentration via:

$$concentration\ [M] = {}^{1}/_{10^{"pH"}}$$